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Open source software: The effects of training on acceptance

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ABSTRACT

Open Source Software (OSS) is an alternative to proprietary software. It is growing in popularity, which has brought about an increase in research interest. Most of the research studies have focused on identifying individual personal motives for participating in the development of an OSS project, analyzing specific solutions, or the OSS movement, itself. No studies have been found which have undertaken research on the impact of user experience and training on OSS. The study reported here sought to identify factors that predict acceptance of technologies based on OSS after training in these solutions. A research model based on the Technology Acceptance Model (Davis, 1989) was developed. Furthermore, the possible moderating effects of users' gender, age and level of education were analyzed. It was found that external determinants such as user training, user fit, technological complexity and trainers' support were important indicators in the success of adopting these solutions.

1. Introduction

Open Source Software (OSS) is a phenomenon of increasing significance (Lundell, Lings, & Lindqvist, 2010). In recent years, it has become a movement popular with end-users, companies and public administrations attracted by the possibility of controlling the design of the software (Höst & Oručević-Alagić, 2011, Rolandsson, Bergquist, & Ljungberg, 2011). So, OSS allows freedom to have access to the system software regardless of associated price or cost. This has brought about an increased interest from the industry on how to use open source components, to participate in the open source community, to build business models around this type of software development, and to learn more about open source development methodologies (Höst & Oručević-Alagić, 2011).

This freedom to access to OSS is divided into four essential parts (GNU, 2013): (1) the freedom to run the program, for any purpose; (2) the freedom to study how the program works, and change how it does your computing as you wish; (3) the freedom to redistribute copies so you can help your neighbor; (4) the freedom to distribute copies of your modified versions to others. Indeed, all OSS licenses are essentially the same with respect to these four freedoms; however, it is worth noting that OSS licenses differentiate in the degree of restrictions imposed on the ability of the user to redistribute modified versions based on a concrete OSS (Sen, Subramaniam, & Nelson, 2011).

In the main, the concern of prior research on OSS is twofold, and in both, the education and training of individuals have a relevant role on the development of these solutions. On the one hand, numerous studies have studied the motivations of his adoption. In this sense, Feller and Fitzgerald (2002) divided the motivational factors into three groups: technological, economic, and socio-political. Similarly, Qu, Yang, and Wang (2011) identified three groups of motivations in an enterprise environment: organizational, technological, and environmental. One year later, Lakka, Michalakelis, Varoutas, and Martakos (2012) analyzed the determinants of the OSS market potential through the case of the Apache web server. Their findings suggest that the diffusion of Apache depends on factors both endogenous and exogenous to a particular country, namely technological infrastructure, level of skills and education, and Information and Telecommunication Technologies trade.

Other studies have analyzed how organizations adopt these solutions. Hauge, Ayala, and Conradi (2010) identified six distinctly different ways in which organizations adopt it: (1) deploying OSS products in their operational environment as end users; (2) using OSS CASE tools in software development; (3) integrating OSS components into their own software systems; (4) participating in the development of OSS products controlled by another organization

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or community; (5) providing their own OSS products and relating to a community around the product; (6) using software development practices, often associated with OSS communities, within a company or consortium of companies (e.g. using practices like code sharing, peer reviewing, user contributions).

In general, all these forms of adoption need the support of educational and training activities (Gallego, Luna, & Bueno, 2008). In fact, the analysis of the relationship between training and the adoption of OSS is recurrent in the literature. In this sense, Carmichael and Honour (2002) concluded that the dynamic and responsive nature of OSS and the existence of freely available documentation and online communities offers an opportunity for educators, network administrators and software developers to participate in the development of resources appropriate to local needs while developing their own skills.

Also, this relationship between his adoption and the support of educational and training activities is treated in research whose objective is to analyze how its helps to hold a strategic position in a knowledge economy (Ajila & Wu, 2007; Yildirim & Ansal, 2011). In this way, many countries are promoting policies to favor its implementation. This is the case in the European Union (EU). It has defined several policy implementation areas that relate to OSS (Bouras et al., 2014) among which are the policies for the educational use of it and its integration in learning environments. Also, many developing countries consider it as a national strategic choice. For that, these countries have increased strategic preference for this software in e-government, knowledge networks and education systems (Yildirim & Ansal, 2011). In the same way, Rooij (2011) affirmed that in international education the adoption of OSS teaching and learning applications is relatively mainstream.

Education and training on OSS are relevant in order to ensure the diffusion from all stakeholder groups (Kemp, 2009) mainly end-users. Besides, end-users and support staff required training to take full advantage of it (Au, Carpenter, Chen, & Clark, 2009). Furthermore, many works study the role of a technology to enhance efficiency and effectiveness and the necessity of introducing some governance mechanisms with this purpose (Milinovic, Tingle, & Vrga, 2003). So, Noni, Ganzaroli, and Orsi (2013) made a dimensional comparative analysis to show the evolution of OSS governance with six categories of governance mechanisms: (1) modularization; (2) division of roles; (3) delegation of decision-making; (4) training and indoctrination (definition of formal procedures and requirements to acquire the status of committed developers); (5) formalization (the introduction of standardized tools and procedures to coordinate activities such as bug reporting, version management, freezing, and so forth); and (6) leadership (autocratic versus democratic). In this same way, Kemp (2010) considered that a training and awareness programmed is of the essence of good OSS governance to ensure that the principles of the OSS strategy and policy are understood and met throughout the organization. In addition, Spinellis and Giannikas (2012) highlighted that the direct intra-organizational network effects on the adoption of this type of technology are associated with the training, among other factors, such as the prevalence of a particular product within the organization where it enjoys advantages over a competing product in the areas of Information Technology (IT) support, and software provision.

Noteworthy in this respect is that all these studies show the necessity of developing training mechanics under an intra-organizational point of view without considering the previous training of the user in OSS. In this sense, the authors have observed that a gap exists concerning the impact of user experience and training on it in the acceptance of this technology. Besides, in a general way, the literature has not considered the possibility that their end-users have received training on these solutions during their education and its impact in the acceptance toward an OSS solution.

Our aim in this paper is to contribute to filling part of that gap. Our main objective is to analyze how OSS training received by the end-user in different educational stages influences acceptance and usage intention toward OSS.

2. Literature review

2.1. Prior research

Usage intention of technology is a research topic widely studied. We can identify hundreds of studies that attempt to analyze the usage intention of the technology from very different points of view (e.g. Hsiao & Yang, 2011; Hsu & Chiu, 2004; Karahanna & Straub, 1999; Teo & Noyes, 2011; Venkatesh & Brown, 2001; Venkatesh & Davis, 2000). All these studies have the objective of determining the factors that influence on the usage intention of the technology, such as social pressure, satisfaction, system support, tool functionality, tool experience, top management support, communication, cooperation, task-technology fit, argument for change, situational involvement, prior usage and training, among other many factors.

Several studies address effects of training on usage intention. Igbaria and Iivari (1995) concluded that training and educational programs may foster a feeling of self-efficacy, that is, the belief that one can develop the experience necessary to use effectively computers and strengthen confidence in one's ability to master and use them in one's work. Also, these authors added that such training and educational programs might emphasize the user friendliness of currently available microcomputers, and the availability of easy to use software packages which require little or no knowledge of programming. Besides, Igbaria, Zinatelli, Cragg, and Cavaye (1997) suggested that individuals without adequate training are likely to experience problems using the system and become reluctant to use the technology, thus defeating the purpose of introducing the new technology. In this same way, Agarwal, Prasad, and Zanino (1996) showed how user perceptions are reasonable predictors of usage intentions, and they recommend the design of user training programs.

Focusing on specific technologies, there are many studies that have examined the effect or impact of user training on user perceptions and usage intention. Karahanna and Limayem, 2000 analyzed the effect of user training on IT usage. They concluded that training was important in highlighting the usefulness of e-mail and in identifying how to take advantage of all the complex features involved in the use of the technology. In a similar way, Rouibah, Hamdy, and Al-Enezi (2009) found that availability of training programs is the strongest determinant of perceived ease-of-use of personal computers. In the case of Enterprise Resource Planning (ERP) systems, other authors, such as Bueno and Salmeron (2008) or Amoako-Gyampah and Salam (2004) showed there exist a positive relationship between training and perceived ease-of-use.

Other researchers have shown a positive effect of user training on perceived usefulness (Hung, Tang, Chang, & Ke, 2009; Lewis, Agarwal, & Sambamurthy, 2003). In this sense, Lewis et al. (2003) affirmed that training, as other institutional factors, has a highly significant influence on individual technology use, and therefore the usefulness of a technology. Similarly, the results of the study of Hung et al. (2009) provided evidence that training is an important factor in the implementation of public electronic administration.

In an OSS context, there is no work conducted with the intention of analyzing in depth this relationship between training and usage intention. Thus, it is important to investigate the educational and training factors that affect the organizations' acceptance of OSS.

2.2. Technology Acceptance Model (TAM)

Many research studies that analyze the usage intention of a technology use the Technology Acceptance Model (TAM) developed by Davis (1989), although other theories exist with the same purpose such as the Theory of Reasoned Action (TRA), which posited that human behavioral intention is affected by attitude and subjective norm (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975) and the Theory of Planned Behavior (TPB) proposed by Ajzen (1991).

Although this model was developed at the end of the 1980s, recent studies show that TAM is still a suitable theoretical framework for assessing the usage intention toward a technology as long as TAM is used inside the context in which it has been validated (Hsiao & Yang, 2011; Turner, Kitchenham, Brereton, Charters, & Budgen, 2010). Other studies have concluded that TAM is a useful model, but has to be integrated into a broader one which would include variables related to both human and social change processes, and to the adoption of the innovation model (Legris, Ingham, & Collerette, 2003).

In a general way, TAM allows analyzing the user acceptance of a technology based on user perceptions through four fundamental variables or constructs. These are: perceived usefulness (PU), perceived ease of use (PEU), usage behavior (UB) and intention to use (IU). PU is "the degree to which a person believes that using a particular system would enhance his or her job performance", and PEU is "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989). Additionally, TAM postulates that UB depends on IU on a technology. UB is based on PU and PEU. Also, PU and PEU are influenced by external variables although Davis (1989) does not detail what factors are exogenous variables.

The TAM differs from other theories, mainly TRA, in two key ways (Dishaw & Strong, 1999): (1) TAM does not need to be tailored to each behavior, as long as that behavior is use of IT; (2) TAM does not include constructs, as subjective norms. Possibly, all these qualities of TAM have led to this model being successfully tested across a wide range of technologies, organizational settings, and user populations (Pai & Huang, 2011).

In early studies, the moderating influence of TAM was applied. This aim of this analysis was to test models, mainly those based on Structural Equation Modeling (SEM). Specifically, moderation effects were introduced into the IT acceptance area to define alternative models of influences and to identify moderating factors (Cheng, Wang, Moormann, Olaniran, & Chen, 2012). In this context, Venkatesh, Morris, Davis, and Davis (2003) found support for the inclusion of moderating variables. Based on this argument, qualitative moderating variables have been introduced into the SEM model here to examine moderation in relation to the demography of OSS users.

3. Hypothesis

3.1. Conceptual model/external variables

Independent of the internal constructs of the TAM model, OSS users consider that the acceptance of it is influenced by some external variables. Therefore, the goal is to identify the external constructs that influence the intention of use of an OSS solution after training. The four TAM constructs and four further external constructs form the first nine hypotheses investigated in this study.

Training is recommended before, during, and after the implementation (Hong & Kim, 2002). Igbaria et al. (1997) examined the impact of internal and external training, internal and external support, and top management support on PU and PEU. They concluded that while internal training had no significant effect on perceived ease of use, it did have a significant effect on perceived usefulness (Amoako-Gyampah & Salam, 2004). More specifically, Lee and Kim (2009) affirmed that user training and experience, which represents individual skills and expertise, are found to be related to user beliefs and usage, and it was suggested that training has a positive effect on PU. Similarly, trainers' support defined as the active participation of trainers in matters linked to OSS also influences adoption success (Chang & Cheung, 2001; Ragu-Nathan, Apigian, Ragu-Nathan, & Tuc, 2004).

Independent of the internal constructs of the TAM model, users see their acceptance of OSS influenced by a series of external variables. Therefore, our goal is to identify the external constructs for the model that influence the user intentions of use these solutions after training. These external constructs include user fit. According to Goode (2005) the ability of OSS products to satisfy users' needs was identified as an important factor that affects its adoption. The OSS solutions that do not adapt to the user requirements will not be used (Tjahjono, 2009). Technological complexity can also be an obstacle to the acceptance of it. Empirical studies show that technological complexity has a significant influence on PEU (Cheung & Huang, 2005; Parveen & Sulaiman, 2008; Son, Park, Kim, & Chou, 2012).

Based on this, the following hypotheses have been formulated, introducing four external constructs into the TAM model: User Training (UT); Trainers' Support (TS); User Fit (UF); and Non-Technological Complexity (NTC). Fig. 1 depicts the research model.

Hypothesis 1 (H1): The perceived ease of use after training on OSS has a positive effect on the perceived usefulness of OSS.
Hypothesis 2 (H2): The perceived ease of use after training on OSS has a positive effect on usage behavior.
Hypothesis 3 (H3): The perceived usefulness after training on OSS has a positive effect on usage behavior.
Hypothesis 4 (H4): The perceived usefulness after training on OSS has a positive effect on the intention to use an OSS solution.
Hypothesis 5 (H5): The usage behavior of a technological solution based on OSS after training will have a positive effect on intention to use.
Hypothesis 6 (H6): User Training in OSS has a positive effect on perceived usefulness.
Hypothesis 7 (H7): User Fit that the OSS offers has a positive effect on perceived usefulness.
Hypothesis 8 (H8): The non-technological complexity of an OSS solution has a positive effect on the perceived ease of use.
Hypothesis 9 (H9): Trainers' support has a positive effect on student usage behavior of an OSS solution.

3.2. Individual moderators

Beyond the indirect influences mediated by external factors, variables have been incorporated into the analysis here that moderate the relationships described in hypotheses H1 through H9.

Many technology acceptance studies neglect the moderating effects of individual factors, although some authors, such as Sun and Zhang (2006), admit that the absence of such characteristics is one of their work's limitations. These same authors identified ten moderating factors and categorized them into three groups: organizational factors, technological factors and individual factors. From a similar perspective, the studies of Venkatesh and Davis (2000) showed that age and gender enrich our understanding of acceptance, and Morris and Venkatesh (2000) demonstrated that decision-making processes by women and men are different.

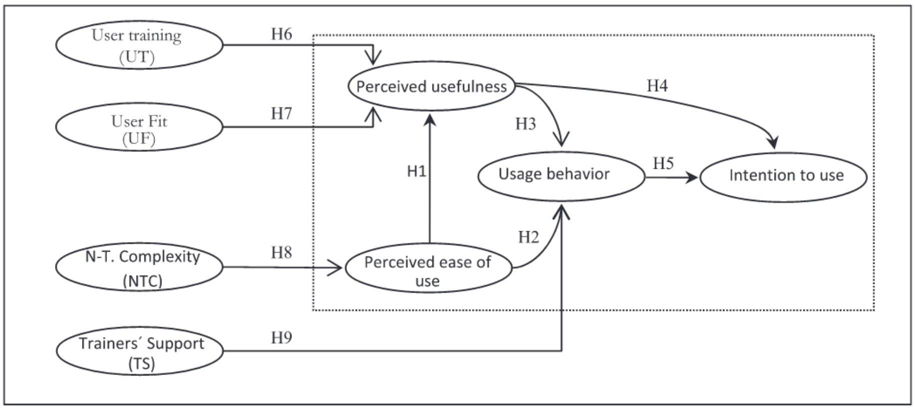

Fig. 1. Proposed research model.

Other studies, such as that of Dambrot, Watkins-Malek, Silling, Marshall, and Garver (1985), found that females displayed a more reluctant attitude toward computers than males. Similar conclusions were noted in the study carried out by Whitley (1997). However, Parasuraman and Igbaria (1990) did not find any relevance between user gender and technological acceptance. Given the existing divergence, the aim here is to analyze the influence of gender on the acceptance of technological solutions based on FOSS.

In general, age is considered by the literature to be a classic demographic variable that influences acceptance of technology. This influence is connected with beliefs about the use of the system and attitudes toward its use (Morris & Venkatesh, 2000).

Specifically, given that this study is defined within an educational environment, the level of education is also a suitable moderator variable. In this respect, higher levels of education have been empirically associated with greater skill in the use and acceptance of new technologies. Davis and Davis (1990) noted that users with higher educational levels got along significantly better in training processes than those with lower educational levels. Similarly, some studies have demonstrated a positive connection between users' training and their beliefs, attitudes and use regarding technology (Igbaria & Nachman 1990; Agarwal & Prasad, 1999).

Based on these suggestions, the following hypotheses have been formulated, describing the moderating effect of gender, age and level of education on the relationship between the independent and dependent variables:

Hypothesis 10 (H10): The acceptance of OSS solutions is different depending on the student's gender.
Hypothesis 11 (H11): The acceptance of OSS solutions is different depending on the student's age.
Hypothesis 12 (H12): The acceptance of OSS solutions is different depending on the student's level of education.

To test these hypotheses, a questionnaire was designed as a necessary tool for obtaining data for this study. The process followed when choosing the sample and designing and validating the questionnaire is explained below.

4. Research methodology

4.1. Data collection

This study utilized a web-based survey to collect data for quantitative testing of the research model. The survey was conducted from December to May 2012. The survey was created with Google Drive. Responses can be exported to comma-separated values (CSV) format, a simple file format used to store tabular data. Files in the CSV format can be imported to and exported from programs that store data in tables, in our case OpenOffice Calc.

The research questionnaire was delivered online through the following steps. First, about 2 weeks after training in some OSS solution, the instructor explained to the students about the study. Then, students could simply click on the hyperlink provided during the class to complete the questionnaire online.

A total of 752 study invitations were provided. In the end, we received 715 survey responses. Of those, 697 were complete and valid for our study. This number represents a response rate of nineteen two percent. It should be noted that students use OSS in most cases inevitably, if not mandatory.

4.2. Participants

The questionnaire was distributed to High school, General Certificate of Education and University students who had been trained in any OSS solution in their class. King and He (2006) confirmed the value of using students as surrogates for professionals in some TAM studies.

In the first part of the questionnaire, students indicated their gender, age, level of education, the frequency of computer use and the main purpose of computer use (Table 1).

With regard to the level of education of respondents, there are 404 high school students, 179 General Certificate of Education (A Level) students and 114 university students. The latter are likely to have been more exposed to OSS due to their age. Besides, 356 students are "less than 15 years old" (S.D. 1.063) and 341 are "more than 15 years old" (S.D. 3.019). Most students (325–56.62%) use the computer several times a day.

Finally, the majority of respondents use computers mainly for study purposes (49% of the sample). Also, we can observe how students use the computer mainly for issues not related to the study and leisure (24%) or for interacting with their friends through the network (27%).

4.3. Measurements

The survey instrument for this study was developed based on a synthesis of relevant findings from prior research on usage intentions associated with IS/IT and a study previously carried out by the authors. A scale for measuring the different TAM model variables was developed using the measures of studies similar to ours. These measurement items are listed in Appendix.

Table 1
Demographic Profile of the respondents.

Characteristic	Statistic	
	N	%
Gender		
Male	298	42.75
Female	399	57.24
Age		
Less than 15 years old	356	51.07
More than 15 years old	341	48.93
Level of education		
High school	404	57.97
General Certificate of Education	179	25.68
University	114	42.03
Use of computer		
Ones or Twice during a week	1	0.001
Several times during a week	2	0.003
One a day	246	42.85
Several times a day	325	56.62
Main purpose of computer use		
Studies	319	48.85
Leisure time	157	24.04
Networking/friendship	177	27.11

A questionnaire was developed with 39 items organized into three sections. In the first part, participants were asked to provide their demographic information. The second section in the survey includes the TAM model variables, organized in four categories. The third section focuses on the external constructs of the TAM model, organized in four categories. Questions utilized in the questionnaire to operationalize the constructs included in the research model were largely adapted from existing literature. The respondents indicated their agreement or disagreement with the above items using a five point Likert-type scale, ranging from "strongly disagree" (1) to "strongly agree" (5).

5. Results

The adequacy of the measurement model was assessed by using a reliability test, a confirmatory factor analysis (i.e. convergent and discriminant validities), and a model fit test.

5.1. Convergent validity

Before assessing the model, we tested the internal consistency of the results. For this, Cronbach's alpha test was applied to the groups of items for the constructs of the model. The reliability of every instrument, as assessed by the value of Cronbach's α reliability coefficient, was between .791 and .861 (Table 2), which is well above the minimum acceptable threshold of .70 (Nunally & Bernstein, 1994). Therefore, the measurement instruments were deemed reliable gauges of the constructs. These results were expected, given the fact that the selected items were taken from similar studies whose predictive capability had been demonstrated (Appendix).

5.2. Convergent validity

Once the explanatory capability of the survey was verified, Fornell and Larcker (1981) suggested using item reliability for each measure, composite reliability for each construct, and the average variance extracted (AVE) to assess the convergent validity of the items measured.

An exploratory factor analysis (EFA) of the different scales was carried out for each one of the constructs of the model using a Kaiser's Varimax Rotation in order to determine the unidimensionality of the scales (Kaiser & Rice, 1974). The extraction method selected was Principal Axis Factoring, as this is the most appropriate method for identifying the constructs (Hair, Anderson, Tatham, & Black, 1998). The EFA was able to demonstrate the unidimensionality of all the constructs in the study. Nevertheless, items PU5 and TS3 have a low factorial charge and for this reason they have been removed from the model. After this modification, the Cronbach's alpha of PU and Trainers' Support (TS) obtains a value of .835 and .827 instead .830 and .718 respectively (Table 2). The AVE is a measure of the overall variance attributed to the construct relative to the variance attributed to measurement error (Fornell & Larcker, 1981). Each construct ranged from .579 to .929, considerably above the threshold of .50, the point above which the variance captured by the construct exceeds the variance due to measurement error (Segars, 1997).

5.3. Discriminant validity

Discriminant validity was tested using the correlation matrix of constructs. If the square roots of the AVEs are greater than the absolute values of the off-diagonal elements in the corresponding rows and columns of the correlation matrix, this suggests that a construct is more strongly correlated with its own indicators than with the other constructs in the model (Son et al., 2012). The diagonal elements of the matrix shown in Table 3 have been replaced, for comparison purposes, by the square root of the average variance extracted (Fornell & Larcker, 1981). All shared variances between any two different constructs were less than the amount of variance extracted by one of the two constructs. Therefore, the constructs of the extended model exhibit adequate discriminant validity.

5.4. Model fit

The model fit of the research model in this study was tested using Lisrel 8.51 structural equations software (2001). Table 4 shows the fit indices for the research model in this study and the recommended value. The result of the model fit indicates that the research model has a good fit above the maximum limits established by Hair et al. (1998).

5.5. Results of structure model for overall data

Our data analysis concerned the examination of the introduced research model in terms of the significances and effect sizes (β) for each hypothesized path, and explained variance (R^2) for each dependent variable. Data analysis was carried out by structural equation modeling (SEM) using Lisrel 8.51. The estimation method used was maximum likelihood. All the proposed hypotheses were supported. The results found show *t*-student values equal to or greater than 1.96. These results demonstrate the statistical significance of the defined relationships (Anderson & Gerbing, 1988). Table 5 summarizes the findings.

As expected, NTC was a significant predictor of PEU (.836, $p < .001$). UT (.149, $p < .05$) and UF (.549, $p < .001$) were significantly related to PU. Likewise, PEU had a significant positive impact on PU (.164, $p < .001$). Moreover, PU (.353, $p < .001$) PEU (.219, $p < .001$) and TS (.351, $p < .001$) had a significant positive impact on UB. Finally, Perceived usefulness and Usage Behavior obtain significant path coefficients with values of .527 and .478 respectively, supporting the contrast with a high level of significance.

Our model explained 82.5% of the variance in intention to continue to use an OSS solution after training, 77.5% of the variance in User Behavior, 53.1% of the variance in PU, and 71.2% of the variance in PEU.

Table 2
Summary of measurement scales.

Construct	Mean	Std. Dev	Lambda stand.	Factor loading	Composite reliability	AVE	Cronbach's α
Perceived ease of use					0.908	0.666	0.860
PEU1	3.51	1.142	0.883	0.780			
PEU2	3.59	1.096	0.793	0.629			
PEU3	3.56	1.104	0.857	0.734			
PEU4	3.56	1.114	0.718	0.516			
PEU5	3.66	1.078	0.818	0.669			
Perceived usefulness					0.929	0.767	0.835
PU1	3.35	1.210	0.917	0.841			
PU2	3.24	1.214	0.843	0.711			
PU3	3.31	1.198	0.893	0.797			
PU4	3.41	1.127	0.847	0.717			
Usage Behavior					0.845	0.699	0.806
UB1	3.35	1.155	0.981	0.626			
UB2	3.31	1.079	0.723	0.523			
UB3	3.24	1.066	0.777	0.458			
UB4	3.27	1.080	0.841	0.707			
Intention to use					0.890	0.730	0.791
IU1	3.45	1.197	0.890	0.792			
IU2	3.67	1.094	0.760	0.578			
IU3	3.25	1.131	0.906	0.821			
User Training (UT)					0.981	0.929	0.838
UT1	3.29	1.178	0.938	0.880			
UT2	3.19	1.190	0.909	0.826			
UT3	3.17	1.137	0.900	0.810			
UT4	3.13	1.402	1.095	1.199			
User Fit (UF)					0.930	0.690	0.861
UF1	3.41	1.216	0.814	0.663			
UF2	3.24	1.142	0.866	0.750			
UF3	3.27	1.103	0.876	0.767			
UF4	3.30	1.132	0.852	0.726			
UF5	3.16	1.188	0.806	0.650			
UF6	3.24	1.209	0.765	0.585			
N-Technological Complexity (NTC)					0.932	0.776	0.831
NTC1	3.36	1.138	0.891	0.794			
NTC2	3.18	1.196	0.781	0.610			
NTC3	3.45	1.231	0.918	0.843			
NTC4	3.60	1.154	0.925	0.856			
Trainerś Support (TS)					0.892	0.735	0.827
TS1	3.21	1.096	0.872	0.760			
TS2	3.34	1.114	0.900	0.810			
TS4	3.35	1.098	0.796	0.634			

Table 3
Discriminant validity of the constructs.

	PEU	PU	UB	IU	NTC	TS	UT	UF
PEU	0.668							
PU	0.291	0.777						
UB	0.450	0.526	0.701					
IU	0.368	0.696	0.610	0.729				
NTC	0.666	0.321	0.630	0.396	0.777			
TS	0.345	0.298	0.510	0.338	0.461	0.751		
UT	0.265	0.384	0.646	0.424	0.429	0.484	0.929	
UF	0.382	0.479	0.699	0.508	0.520	0.490	0.692	0.690

Table 4
Overall fits of models.

Fit index	Results	Recommended value
χ^2/grade of freedom	2.263	$\leqslant$3.00
Normed Fit Index (NFI)	0.919	$\geqslant$0.90
Non-normed Fit Index (NNFI)	0.947	$\geqslant$0.90
Comparative Fit Index (CFI)	0.953	$\geqslant$0.90
Adjusted Goodness-of-Fit Index (AGFI)	0.896	$\geqslant$0.80
Root Mean Square Error of Approximation (RMSEA)	0.0437	$\leqslant$0.05
Goodness-of-Fit Index (GFI)	0.913	$\geqslant$0.90
Incremental Fit Index (IFI)	0.953	$\geqslant$0.90

5.6. Results of moderator effects

The hypotheses about the moderating effects of user variables were tested by comparing path coefficients between the two groups for each moderator. In this respect, a multi-group analysis procedure was used to test the moderating effects of gender, age and level of education. Students were divided into three groups, male–female students; young-old students and high school-university students. Based on these three groups, six models were examined to analyze the effects of moderating variables on acceptance. All the models obtained significant results. Table 6 shows the results of path coefficients comparisons.

The path coefficient for males from PEU to PU was significantly larger than for females. However, the other paths were not significantly affected by gender. Furthermore, PEU was a more important factor for younger and lower-level students than for older and higher-level students in providing PU and AU. However, in the paths from User fit to PU, the coefficients from older and higher-level students were significantly stronger than those from younger

Table 5
Hypothesis testing results.

No	Hypothesis	Coefficients	*T*	Support
H1: PEU → PU	The PEU after training on OSS has a positive effect on the PU of OSS	.164	3.405	Yes***
H2: PEU → AU	The PEU after training on OSS has a direct and positive effect on UB	.219	5.656	Yes***
H3: PU → AU	The PU after training on OSS has a direct and positive effect on UB	.353	9.017	Yes***
H4: PU → IU	The PU after training on OSS will have positive and direct effect on IU	.527	8.877	Yes***
H5: AU → IU	The UB on OSS after training on it will have a positive and direct effect on IU	.475	7.205	Yes***
H6: UT → PU	User Training in OSS has a positive effect on perceived usefulness	.149	1.989	Yes*
H7: UF → PU	User Fit that the OSS offers will have a positive direct effect on the perceived PU	.549	5.647	Yes***
H8: NTC → PEU	The non-technological complexity of an OSS solution has a positive effect on PEU	.836	18.058	Yes***
H9: TS → AU	Trainers' support has a positive effect on student usage behavior of an OSS solution	.351	8.183	Yes***

Signification levels: ** $p < .01 - t(.01;\infty) = 2.5904$,
* $p < .05 - t(.05;\infty) = 1.9670$,
*** $p < .001 - t(.001;\infty) = 3$.

and lower-level students. Lastly, the study showed that user training had a greater effect among lower-level students than higher-level students.

The mediation testing results are given in Table 7. The results indicate that there are significant differences in the IU between male and female students. This study also confirmed that women were more influenced by PEU than men, with values of .748 and .691.

With regard to the users' age, there are no significant differences in the IU between the users (.816 and .820). Furthermore, the sub-group made up of younger users perceived more PEU (.758) than the older users (.666) while the latter perceived more PU (.580) than the younger students (.466).

Finally, regarding the level of education, higher-level students have a higher IU (.842) than lower-level students (.809), and students with a lower level of education score higher values for PEU and UB than the others.

6. Discussion

This study has tested hypotheses on the relationship between OSS training and acceptance. Concretely, OSS training has a positive impact on student usage behavior of an OSS solution. The results are in line with previous studies. With this in mind, Igbaria and Iivari (1995) concluded that training and educational programs may foster a feeling of self-efficacy and emphasize the user friendliness toward the technology. In a similar way, Agarwal et al. (1996) recommended the design of user training programs to increase the usage intentions of a technology.

Similarly, the findings are consistent with the background of the introduction section. On the one hand, our results confirm the necessity described by Gallego et al. (2008) of implementing educational and training activities with the intention of supporting the adoption and acceptance of OSS technologies and ensure the diffusion from all stakeholder groups, mainly end-users (Kemp, 2009). On the other hand, as a consequence of these findings, they show the opportunity for educators, network administration and software developers to participate in the development of resources appropriate to local needs to improve the adoption of OSS (Carmichael & Honour, 2002). In a similar way, our work has consolidated the idea of considering the previous training of the user in these solutions when an organization needs to develop training mechanics under an intra-organizational point of view (Spinellis & Giannikas, 2012). In such settings, the perceived usefulness of the technology and its ease of use may be the dominant predictors of its use (Lee & Park, 2008; Sørebø & Eikebrokk, 2008; Vijayasarathy, 2004).

Concretely, these results identified a number of variables that determine acceptance of OSS solution. Our research model, designed from prior literature and previous studies by the authors (Amoako-Gyampah & Salam, 2004; Bueno & Salmeron, 2008; Calisir & Calisir, 2004; Davis, 1989; Gallego et al., 2008; Riemenschneidera, Harrisonb, & Mykytyn, 2003; Venkatesh & Davis, 2000) received overall strong support from the data and it confirms the relationships as we expected. Data indicate that the structural model offers an adequate fit of the proposed relationships regarding the technological acceptance of an OSS solution.

Overall, our analysis clearly confirms the positive influence of training and intention to use an OSS solution. One important finding in this study is concerned with the determinants of IU. Concretely, the IU is explained by the model widely, with a $R^2 = .825$. This finding means that the IU construct was predicted by user training (UT), user fit (UF), N-T. Complexity (NTC), Trainers' support (TS), Perceived ease of use (PEU), perceived usefulness (PU) and usage behavior (UB), and these variables together explained 82,5% of the variance in IU, indicating a high overall R-squared value. Other similar studies with a structural model based on TAM reach results with a high level of significance, although with lesser R^2, for example, Yi, Jackson, Park, and Probst (2006) with a $R^2 = .57$ or Cheung and Vogel (2013) with a $R^2 = .39$.

Furthermore, some key findings were identified. So, UB and PU after training on OSS solutions have a direct influence on user IU (Hypotheses H4 and H5). These results were expected based on the findings of Davis (1989), Turner et al. (2010), Hsiao and Yang (2011) and Legris et al. (2003). They show that the success of adoption an OSS solution depends on the UB and PU received during the training. Also, they suggest that training has a direct impact in further adoption of OSS solutions.

Furthermore, the constructs PU, PEU and TS have a direct influence on UB (Hypotheses 2, 3 and 9). These findings were supported by the studies of Chang (2001), Davis (1989) and Ragu-Nathan et al. (2004) indicated that the perception of usage behavior tends to develop through a process of training and exposure to the OSS. Therefore, students who find the system useful and easy to use in their learning process are more likely to adopt the system.

Additionally, we found that PEU has a positive effect on PU (Hypothesis 1). It means that OSS users recognize the usefulness of this type of software when it is easy to use. From this perspective, this finding suggests that developer and firms that providers it should put more effort into developing solutions easy to use. Further, UT and UF have and direct and positive impact on PU (Hypotheses 6 and 7). In this sense, users with technical expertise and training on OSS appear to be important when considering it as a utility solution (Amoako-Gyampah & Salam, 2004; Goode, 2005; Igbaria et al., 1997; Lee & Kim, 2009; Tjahjono, 2009).

Table 6
The results of moderate effects.

Path	Gender			Age			Education		
	Male	Female	Support	Young	Older	Support	Less	Higher	Support
H1: PEU → PU	.376***	.0646*	Yes	.224***	.0916*	Yes	.167***	.0856**	Yes
H2: PEU → AU	.175**	.280***	No	.346***	.123**	Yes	.321***	.0719*	Yes
H3: PU → AU	.286***	.283***	No	.337***	.371***	No	.384***	.365***	No
H4: PU → IU	.459***	.580***	No	.525***	.565***	No	.554***	.583***	No
H5: AU→ IU	.537***	.427***	No	.474***	.484***	No	.456***	.472***	No
H6: UT → PU	.0827	.168*	No	.242**	.105*	No	.370***	.0175*	Yes
H7: UF → PU	.477**	.579***	No	.337**	.728***	Yes	.216**	.887***	Yes
H8: NTC→ PEU	.740***	.905***	No	.786***	.896***	No	.797***	.896***	No
H9: TS → AU	.407***	.266***	No	.315**	.346***	No	.305***	.379***	No

PEU: perceived ease of use; PU: perceived usefulness; UB: usage behavior; IU: intention to use; UT: User Training; TS: Trainerś Support; UF: User Fit ; NTC: Non-Technological Complexity.
Signification levels :
* $p < .05 - t(.05;\infty) = 1.9670$,
** $p < .01 - t(.01;\infty) = 2.5904$,
*** $p < .001 - t(.001;\infty) = 3$.

Table 7
Moderation model tests.

	Gender		Age		Education	
	Male	Female	Young	Older	Less	Higher
PEU	.691	.748	.758	.666	.710	.668
PU	.520	.558	.466	.582	.509	.592
UB	.808	.777	.764	.762	.783	.759
IU	.898	.775	.816	.820	.809	.842

In line with this interpretation, non-technological complexity appears to be a strong component for users toward PEU of an OSS solution (Hypotheses 8). If a technology is perceived to be difficult to learn and use, it is likely to be perceived to be tedious and users tend to look for another solutions. This indicated that users can accept or reject it in relation with it technological complexity (Cheung & Huang, 2005; Parveen & Sulaiman, 2008; Son et al., 2012).

These findings provide evidence that in an educational environment based on technology, trainers' support is an important factor that has an influence positive and direct on usage behavior. This result highlights the important influence that trainers have toward the users' acceptance of OSS solutions. Trainers can promote user technology acceptance more effectively and efficiently.

Another important issue examined in this study was the influence of factors related with demographic dimensions (gender, age and level of education). The results show the influence of gender on acceptance of an OSS solution. In this respect, trainers can develop specific tactics focusing on how to increase PEU for men while increasing PU among women. Furthermore, levels of education influence some aspects: OSS acceptance decreases among students with a lower level of education. To enhance learning performance, students need different training programs that respect the different levels of education. Finally, there are no significant differences between IU and the age of the student. PEU was found to be higher for young students, but PU was higher for older students. By taking these factors into account, OSS developers and trainers can take the required measures to predict or promote user technology acceptance more effectively and efficiently.

7. Conclusions

Little research has tested the acceptance of OSS solutions, and more specifically none have looked at training. This study is an attempt to rectify this. To investigate the factors that influence successful acceptance of OSS solutions, this study extended the technology acceptance model, and demonstrates the impacts of individual and technological issues on user intention to use.

In this sense, the aim of this work was to evaluate the impact of training in OSS usage intention. Based on the findings we can define some implications. On one hand, from an academic perspective, this article contributes to the development of knowledge about the acceptance of OSS technologies. So, this article has laid a foundation for further studies to evaluate empirically the impact of training in this technological environment. On the other hand, from a managerial perspective, this article highlights how training and complexity of the technology can help achieve better conditions for technology acceptance.

This research suggests several implications for both developers and users of OSS solutions. First, the acceptance of these solutions in students after training is superior to users without training in it. It is therefore believed that students who find the system useful and easy to use in their learning process are more likely to adopt an OSS solution. Second, this study finds that external determinants such as user training, user fit, technological complexity and trainers' support are factors that are critical to the success of his adoption.

There are two main limitations in this study. First, only Spanish students participated in our study, the results would be more interesting if other student groups could be studied. The second limitation is that the relationships between user training and perceived usefulness have a low significance, and therefore the proposed construct may need further refinement.

Besides these two limitations, we must add a limitation with respect the selected methodology and sample. In this way, TAM does not permit to analysis the profit of using OSS and as a consequence we cannot define practical implications about the improving of organizational productivity and efficiencies. In this manner, TAM measures the intention of usage based on users' perceptions regarding the effect of a technology in his/her work. In this sense, it would be interesting to analyze in futures studies how these findings influence on the profit of an organization. With respect to the sample, it is appropriate to indicate that the results could have improved using a sample where students can freely choose between OSS and other alternatives.

Overall, our analysis clearly confirms the importance of training in the acceptance toward OSS solutions. The intended use of the participants in our study is much higher than results achieved in similar studies. Most respondents will use it if they will be accessible to them. We believe that these results are due to the direct and positive influence that training and exposure to these solutions have in acceptance and adoption.

Appendix A. Questionnaire

Theory construct – item definition	
PEU	PEU1 – My interaction with the OSS solution is clear and understandable PEU2 – It is easy for me to remember how to perform tasks using an OSS solution PEU3 – I find the OSS solution to be easy to use PEU4 – Interacting with the OSS solution does not require a lot of mental effort PFU5 – Overall, I find OSS solutions easy to use
PU	PU1 – Using an OSS solution gives me greater control over my work/study/life PU2 – Use an OSS can decrease the time needed for my work/study/life tasks PU3 – Using an OSS solution improves the performance in my studies PU4 – Using an OSS solution increase the effectiveness of my interaction with my computer PU5 – The OSS solution will provide access to more data
UB	UB1 – The OSS solution provide integrated, timely and reliable information UB2 – The OSS solution make data analysis easier UB3 – The OSS solution provide accurate information UB4 – I believe that my interactions with the OSS solution will be effective
IU	IU1 – Assuming I have access to an OSS solution, I will use it IU2 – I expect the information from an OSS solution will be useful IU3 – I expect to use OSS solutions.
UT	UT1 – The kind of training provided to me was complete UT2 – My level of understanding was substantially improved after going through the training program UT3 – The training gave me confidence in OSS solutions UT4 – The training was of adequate length and detail
UF	An OSS solution. . .. UF1 – . . . was designed for all levels of users UF2 – . . . provides flexible user guidance UF3 – . . . provides good training for different users UF4 – . . . has enhanced the functionality of applications that you use UF5 – . . .has less number of errors with respect other proprietary solution UF6 – . . . requires less maintenance that other proprietary solution
NTC	NTC1 – It is easy to understand what is going on with an OSS solution NTC2 – Using an OSS solution involves few time. NTC3 – An OSS solutions takes short time to learn how to use it NTC4 – In general, an OSS is very easy to use
TS	TS1 – Trainers are interested in OSS solutions TS2 – Trainers understand the importance of OSS TS3 – Trainers support the OSS solutions TS4 – Trainers understands the OSS opportunities

Adapted from: Amoako-Gyampah and Salam (2004), Calisir and Calisir (2004), Chang (2001), Davis (1989), Green, Hevner, and Collins (2005), Riemenschneider et al. (2003), Thompson, Higgins, and Howell (1991), Venkatesh and Davis (2000) and Ragu-Nathan et al. (2004).

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